



FIS Architectures

*Weather Accident Prevention Annual Project Review
November 2002*

The Johns Hopkins University
Applied Physics Laboratory
in support of the
NASA Glenn Research Center

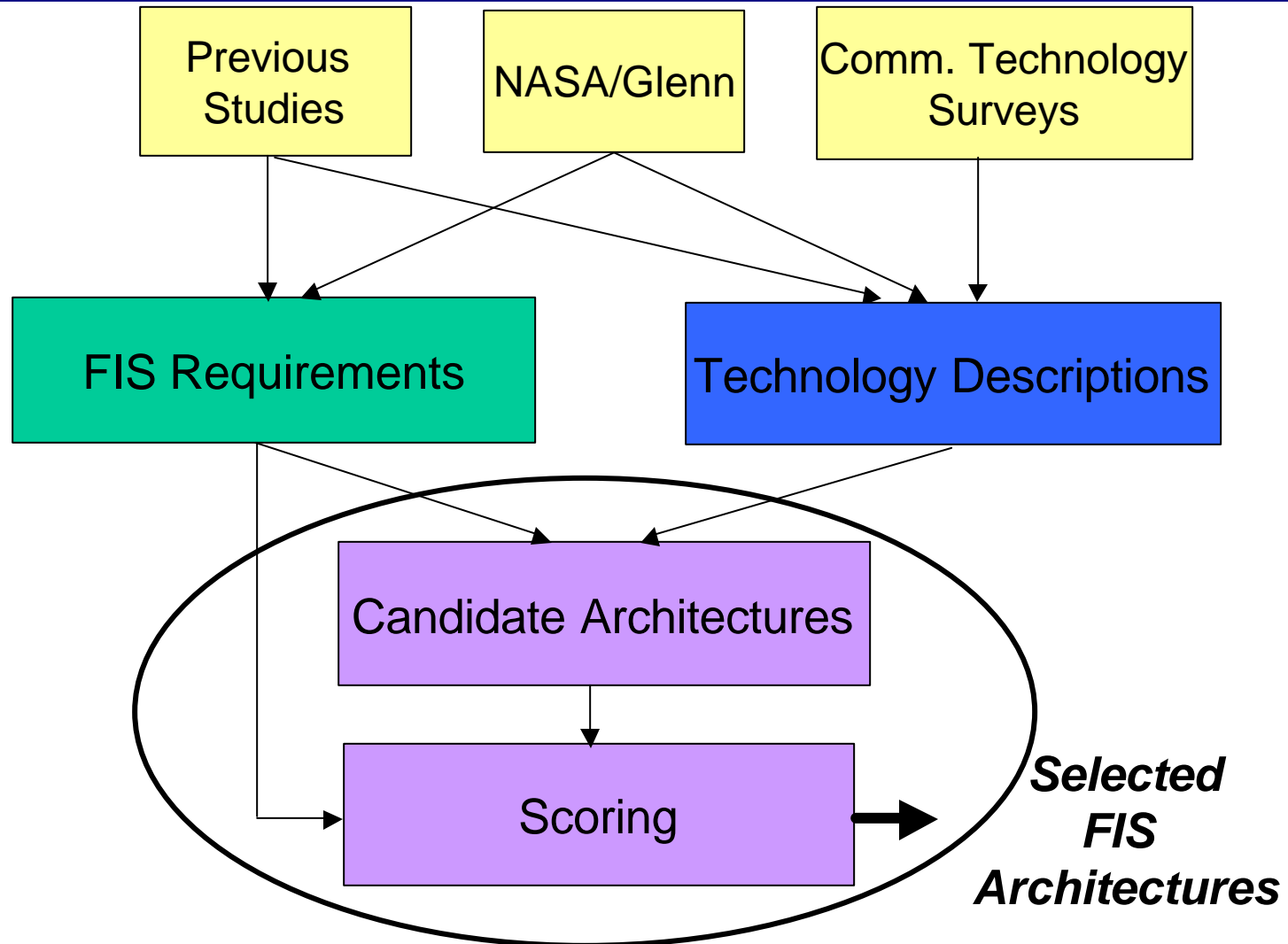


Outline

- Architecture Analysis Process and Requirements Summary
- Scoring Methodology
- SATCOM Architectures and Scores
- LOS Architectures and Scores
- Hybrid Architectures
- Alternative Architectures
- Summary



Architecture Analysis Process





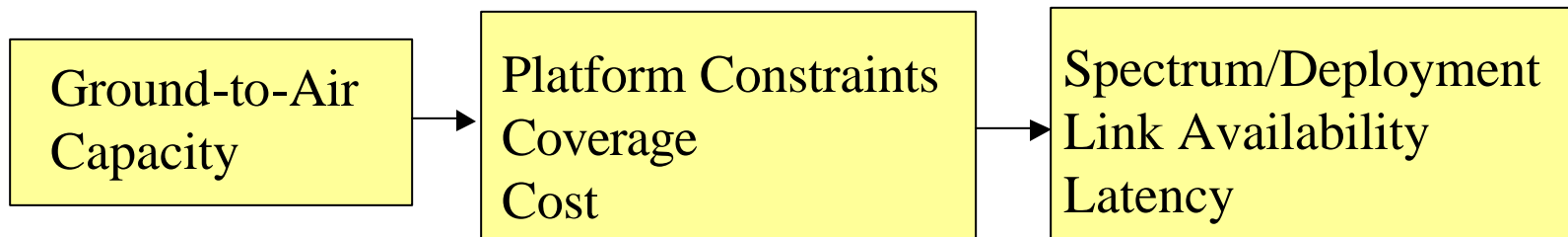
Requirements Summary

| Scoring Rqmt Area | Summary Requirements |
|------------------------|--|
| Ground-to-Air Capacity | High-Fidelity, Comprehensive: 183 kbps Multi-Fidelity, Comprehensive: - regional: 1.3 kbps - CONUS: 38 kbps |
| Platform Constraints | Appropriate for GA/regional aircraft |
| Coverage | CONUS and Global |
| Cost | Under \$5000 NRE; minimum recurring |
| Spectrum/Deployment | System operational by 2007 and 2015 |
| Link Availability | 99% |
| Latency | 5 minutes |



Scoring Methodology

- Scoring conducted through a series of "filters"
- Only viable technologies passed to next scoring filter

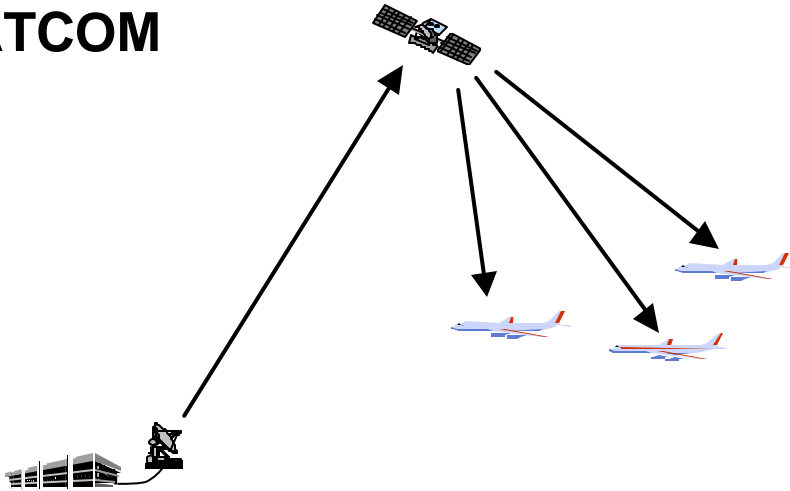


| Score | Description |
|-------|--|
| -1 | System does not meet requirements |
| 0 | Information obtained is currently inadequate to score |
| 1 | System can support requirement |
| 2 | System can support requirement with substantial margin |

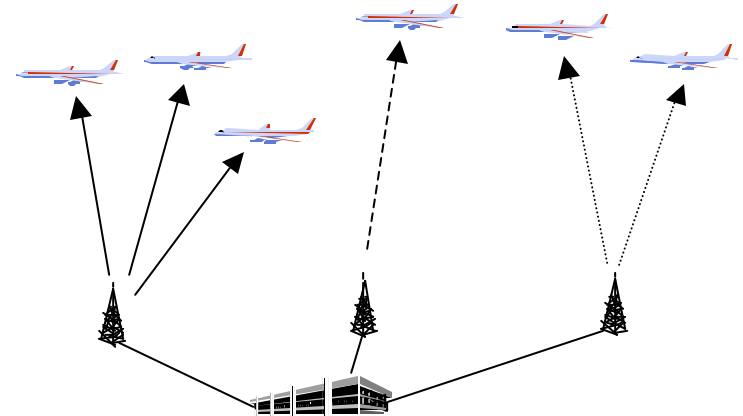


Architectures (Broadcast)

SATCOM

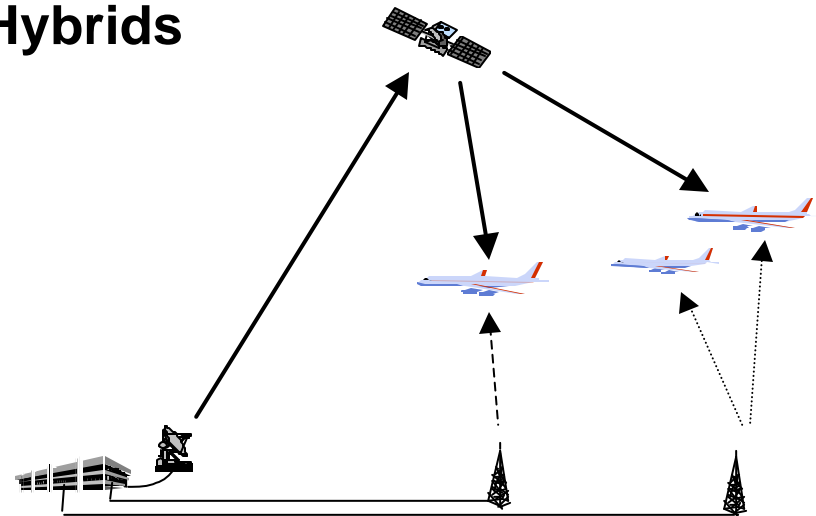


LOS - Broadcast



- Completed preliminary scoring of architectures
- Further detailed engineering analysis needed on several options

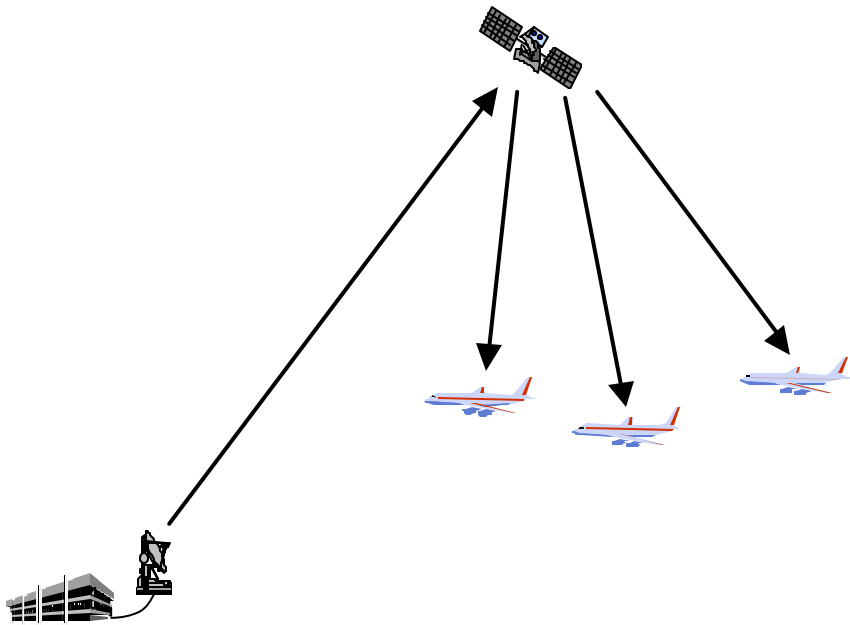
Hybrids



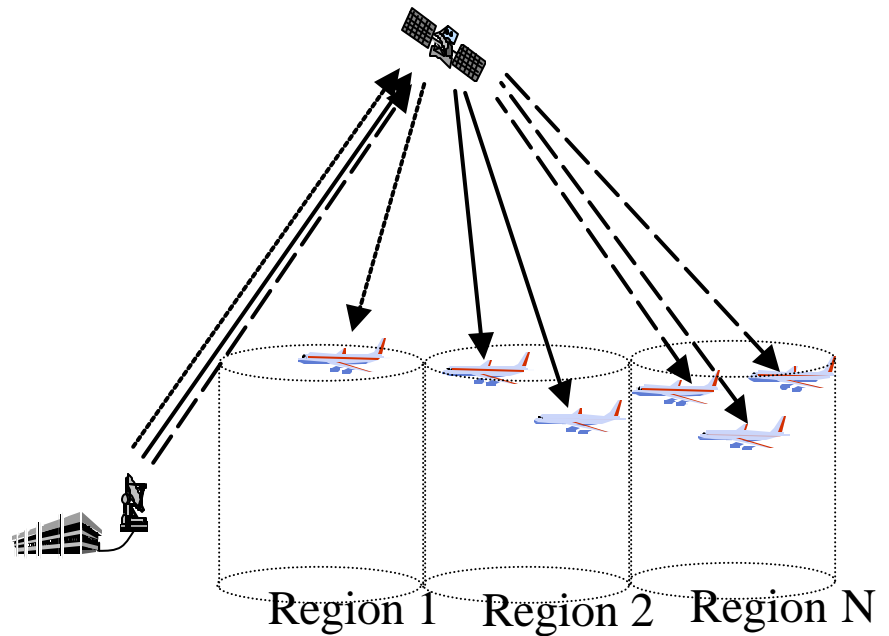


SATCOM Architectures

- Different architectures are applicable to different distribution methods



HFCD



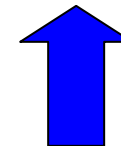
MFCD



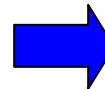
SATCOM Scores

- Volatility in some sectors of SATCOM industry is an important consideration
- Several open questions on technical system details

| System | Spectrum/ Deployment | Link Availability | Latency |
|------------|-------------------------|----------------------|---------|
| Iridium | 1 | 0 | 2 |
| Globalstar | 1 | 0 | 2 |
| ICO | 1 | 0 | 2 |
| Ellipso | 1 | 0 | 2 |
| Inmarsat | 2 | 0 | 2 |



| System | HFCD | MFCD | |
|-------------------|------|----------|-------|
| | | regional | CONUS |
| Iridium | -1 | 2 | -1 |
| Globalstar | -1 | 2 | -1 |
| ICO | 2 | 2 | 2 |
| Ellipso | -1 | 2 | -1 |
| Teledesic | 2 | 2 | 2 |
| Inmarsat | 2 | 2 | 2 |
| Spaceway | 2 | 2 | 2 |
| eSAT | -1 | 2 | 2 |
| UHF | -1 | 2 | 1 |
| SHF | 2 | 2 | 2 |
| S-DARS | 0 | 2 | 0 |
| Store-and-Forward | -1 | 0 | -1 |

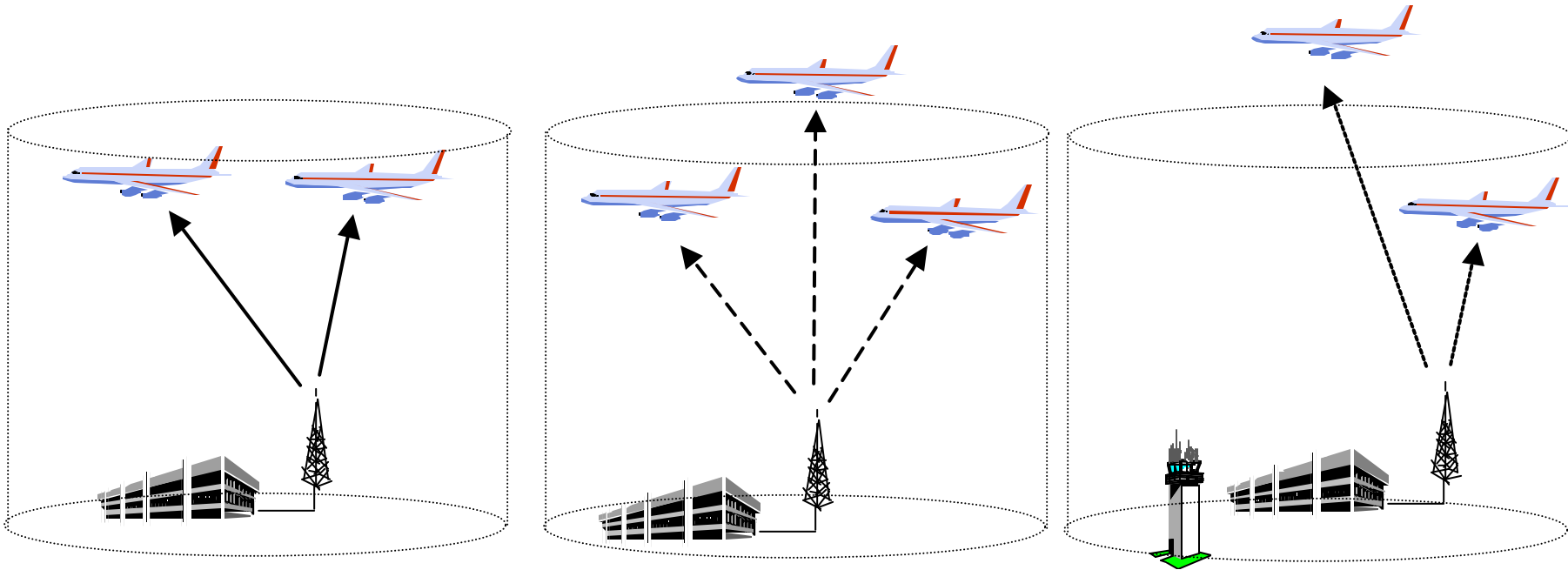


| System | Platform Constraints | Coverage | Cost |
|------------|-------------------------|----------|------|
| Iridium | 2 | 2 | 2 |
| Globalstar | 2 | 2 | 2 |
| ICO | 1 | 2 | 1 |
| Ellipso | 1 | 2 | 1 |
| Teledesic | -1 | 2 | -1 |
| Inmarsat | 2 | 2 | 1 |
| Spaceway | -1 | 2 | -1 |
| S-DARS | 0 | 2 | 0 |



LOS Architectures

- Single architecture but product content would vary depending on distribution approach (MFCD, HFCD)



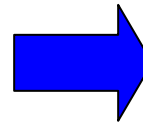


LOS Scores

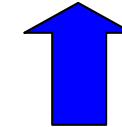
- LOS systems do not provide viable options for the larger distributions
- Several open questions on technical system details

| System | Spectrum/ Deployment | Link Availability | Latency |
|---------|-------------------------|----------------------|---------|
| VDL M2 | 2 | 2 | 2 |
| VDL M3 | 1 | 0 | 2 |
| 1090ES | 1 | 1 | 2 |
| UAT | 1 | 1 | 2 |
| DARC | 1 | 0 | 2 |
| Aircell | 2 | 0 | 2 |
| ACARS | 2 | 2 | 2 |

| System | HFCD | MFCD | |
|-------------|------|----------|-------|
| | | regional | CONUS |
| VDL M2 | -1 | 2 | -1 |
| VDL M3 | -1 | 2 | -1 |
| VDL M4 | -1 | -1 | -1 |
| 1090 ES | -1 | 1 | -1 |
| UAT | -1 | 2 | -1 |
| GATElink | 2 | 2 | 2 |
| HFDL | -1 | 1 | -1 |
| DARC | -1 | 2 | 2 |
| 3G Cellular | 0 | 2 | 2 |
| 4G Cellular | 0 | 2 | 2 |
| Aircell | -1 | 2 | -1 |
| Magnastar | -1 | 2 | -1 |
| Mobitex | -1 | 2 | -1 |
| ACARS | -1 | 2 | -1 |
| AAN | -1 | 2 | -1 |



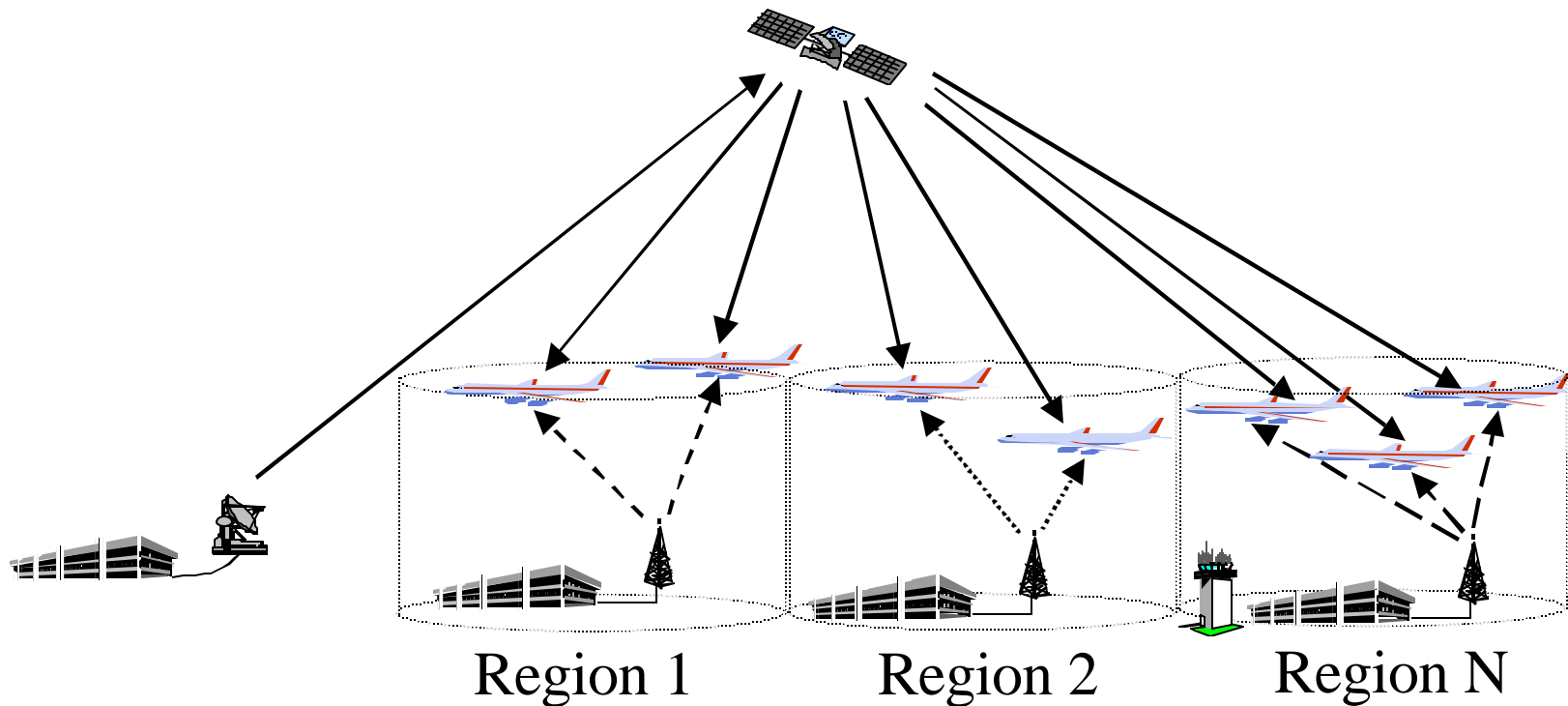
| System | Platform Constraints | Coverage | Cost |
|-------------|-------------------------|----------|------|
| VDL M2 | 2 | 2 | 0 |
| VDL M3 | 2 | 2 | 0 |
| 1090ES | 2 | 2 | 1 |
| UAT | 2 | 2 | 1 |
| GATElink | 2 | -1 | 0 |
| HFDL | 2 | 2 | -1 |
| DARC | 1 | 0 | 0 |
| 3G Cellular | 1 | -1 | 0 |
| 4G Cellular | 1 | -1 | 0 |
| Aircell | 2 | 1 | 1 |
| Magnastar | 2 | 1 | -1 |
| Mobitex | 1 | -1 | 0 |
| ACARS | 2 | 2 | 2 |





Hybrid Architectures

- Logical choice is SATCOM for CONUS product delivery and LOS for regional product delivery in an MFCD approach





Hybrid Scores

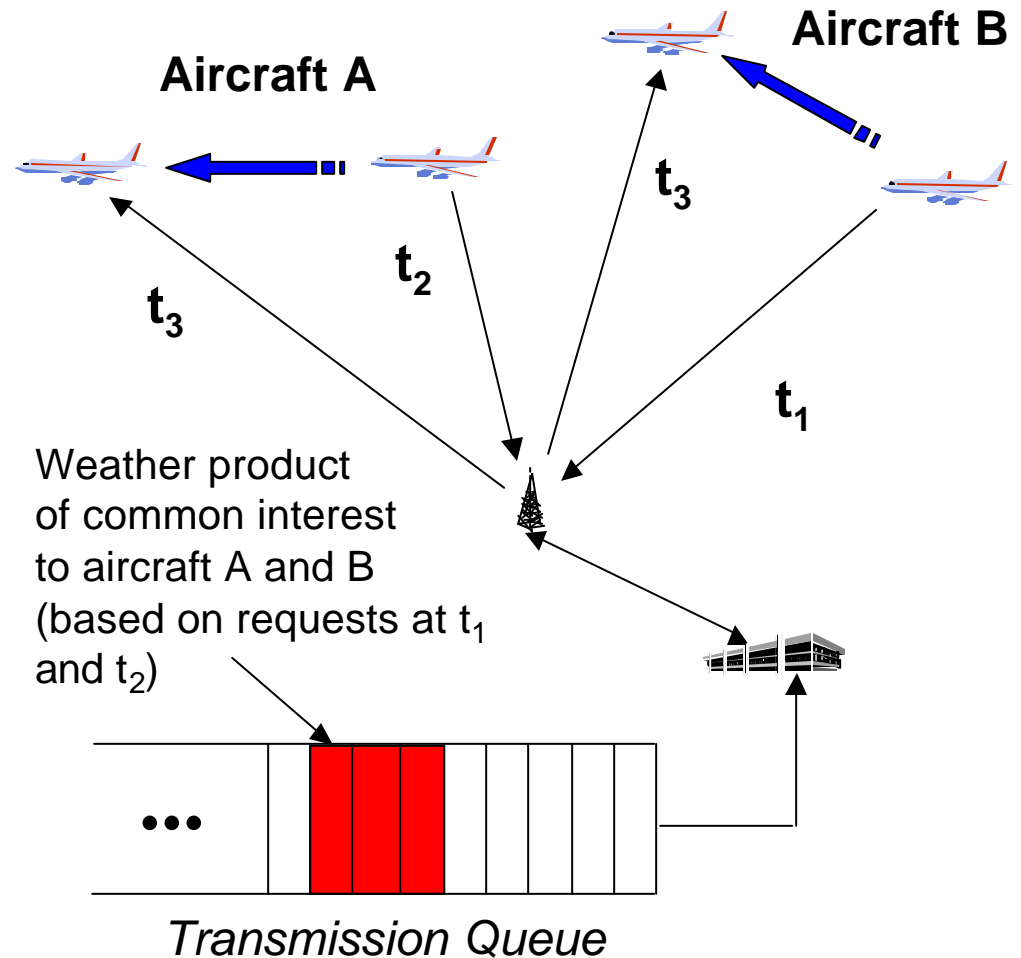
- Based on earlier scoring (partitioned by distribution method) the following emerge:
 - SATCOM: Inmarsat, ICO, S-DARS, eSAT
 - LOS: VDL M2, VDL M3, 1090ES, UAT, DARC, Aircell, ACARS
- Qualitative considerations:
 - Business cases for "piggybacked" requirements
 - No hybrid is likely to meet price point
 - Utilize links that may already be on aircraft
 - VHF transition
 - More detailed technical assessment



Alternative Architectures

- Broadcast has been studied in current effort
- Other architectures are important to consider for potential improved resource efficiency
 - Request/Reply
 - Adaptive Request/Reply
 - Others

Notional Example





Summary

- Goal of task is to determine the best communications architecture to support FIS
- A process has been developed to enable an independent assessment while leveraging the substantial investments already made
- Further engineering details will help refine scoring